Integrating REA and XBRL GL to Facilitate Modern Business Reporting

Denise Guithues Amrhein, Ph.D., CPA
Department of Accounting
John Cook School of Business
Saint Louis University
USA

Abstract

Debreceny and Gray (2003) examined the ontological underpinnings of the eXtensible Business Reporting Language (XBRL) while Geerts and McCarthy (2004) and Buder and Koschtial (2009) examined the ontological underpinnings of the Resource-Event-Agent (REA) model. What has been lacking is an assessment of the complementary nature of these two ontologies. We propose that synergistic benefits can be achieved by combining eXtensible Business Reporting Language Global Ledger (XBRL GL) and the timeless REA-Enterprise Ontology (REA-EO) model. The timeless REA-EO semantic model is the means to articulate the organization's information needs while XBRL GL is the information standard for instantiating an organization's information needs with tagging that provides agreed-upon meta descriptions of data elements/attributes, business rules, and references. This paper examines how the combination of XBRL GL and REA can facilitate increased adaptability and re-usability of business information which is needed to serve today's dynamic business environment.

Keywords: Ontologies, REA, REA-EO, XBRL GL

1. Introduction

In today's complex interconnected global business environment, "spatial, temporal, geographical, jurisdictional, risk and organizational dimensions of transactions need to be captured and processed in a more integrative fashion than traditional double-entry bookkeeping allows" (Cheh 2005, 25). McCarthy (1982) proposed the Resource-Event-Agent (REA) model as a means to overcome the deficiencies of double-entry bookkeeping. Once the information concerning these business transactions has been captured and processed, the next step is to disseminate that information to decision makers and other interested parties for their use. "To support the sharing and reuse of formally represented knowledge among AI systems, it is useful to define the common vocabulary in which shared knowledge is represented" (Gruber 1993, 199). The eXtensible Business Reporting Language Global Ledger (XBRL GL) provides such a vocabulary. XBRL GL is a specialized taxonomy for the tagging of financial and non-financial information at the granular level so that it may be shared across disparate systems.

The XBRL GL taxonomy represents an ontology in that it represents agreed upon definitions and relationships between the XBRL GL taxonomy elements. While the generalized XBRL GL taxonomy is quite comprehensive it is likely that company and industry specific extensions1 will be required to fully satisfy reporting needs. In fact, the need for additions such as more powerful templates (e.g., within the measurable structure or audit/workflow) and queries to XBRL GL has been recognized (XBRL Intl. 2007). Because taxonomies will be used for a significant period of time, it is important to apply a consistent thought process to the development of extensions so that they follow a consistent and logical pattern and do not become absent of fundamental ontological and design principles. The goal of any extensions to the XBRL GL taxonomy should be consistent with the GL philosophy whereby elements and structures are holistic and reusable. Further, extensions should make use of established standards (i.e., the International Standards Organization (ISO)) and formal modeling approaches when they exist. We build on the suggestion of Debreceny and Gray (2003, 8) who suggest REA as an appropriate modeling grammar for the XBRL ontology.

The challenging transition from a traditional double-entry system to a multifaceted contemporary system can be facilitated by combining the timeless REA-EO and the XBRL-GL ontologies. As with ontologies in other areas that are being designed "for the purpose of enabling knowledge sharing and reuse" (Gruber 1992), both REA and XBRL GL are intended to facilitate the sharing of information.

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1 We use the term extensions to include both the addition of new elements and modifications to enumerations contained in the XBRL GL taxonomy modules.

The REA-EO model can provide valuable guidance in developing a strong common vocabulary based on sound ontological principles and extensions consistent with that vocabulary. We suggest the timeless REA-EO as an appropriate choice for the modeling and development of XBRL GL taxonomy extensions. In addition to providing a comprehensive conceptual model to follow for enterprise system design, it is consistent with the existing XBRL GL taxonomy. An instance document mapped to a REA-EO extended XBRL GL taxonomy provides synergistic benefits with XBRL GL contributing more transparent and timely business reporting across information systems and the REA-EO providing more comprehensive reporting. Moving from a paper centric model of tagging financial statement data after the fact to a data centric view where data is tagged at the source would increase the reusability of data for both internal and external use. This reusability is necessary to efficiently meet the information requirements of modern organizations.

In the next section we provide a discussion of ontologies followed by a discussion of the fundamental ontological underpinnings of XBRL in general, XBRL GL specifically, and the REA-EO model. In the third section we discuss how to model an organization's business processes using the REA-EO model and then tag those elements with existing XBRL GL elements, through reference to existing external standards, modifications to the existing XBRL GL enumerated values, and extensions to the XBRL GL taxonomy when necessary. The final section includes conclusions and recommendations for future research.

II. BACKGROUND

Ontologies

The analysis of ontologies has received little attention within the accounting research domain. The limited attention that ontologies have received has been within the accounting information systems field. Although there is some disagreement as to what an ontology is within the artificial intelligence (AI) realm, Gruber (1992) provides a succinct definition--"An ontology is a specification of a conceptualization." Gruber (1995, 908) expanded the definition to a "formal, explicit specification of a shared conceptualization." The study of ontologies in accounting is important because using an explicit specification facilitates the reuse and sharing of knowledge across multiple platforms. This ability to share knowledge across platforms is critical to success in today's global dynamic operating environment where multinational corporations and international trading partners must consolidate and/or share information maintained on disparate systems.

Although there is some disagreement as to what constitutes a good ontology those attributes identified by Gruber (1995, 910) have appeal. Clarity, the first of Gruber's criteria, implies clear definitions that are context independent. Coherence, the second criteria, requires consistency in the application of the definitions within the domain. Extensibility, the third criteria, implies the ability to meet the needs of changing foundations and best practices. Fourth, there should be minimal encoding biases so that coding is neither constrained nor are coders forced to exhibit biases in the coding of knowledge. Lastly, there should be minimal ontological commitment so that it makes few pre-conceived requirements about the modeled environment.

Extensible Business Reporting Language (XBRL)

"**XBRL** is a language for the electronic communication of business and financial data which is revolutionising business reporting around the world. It provides major benefits in the preparation, analysis and communication of business information. It offers cost savings, greater efficiency and improved accuracy and reliability to all those involved in supplying or using financial data" (XBRL Intl. 2009a). Extensible Business Reporting Language (XBRL) is a derivative of Extensible Markup Language (XML) that uses data tags to contain meta-data. Debreceny and Gray (2003) reverse engineered the draft US GAAP and International Accounting Standards (IFRS) taxonomies to examine the underlying ontological structure and suggested REA as an appropriate modeling grammar for the XBRL ontology. . Most applications of XBRL have been in government and external financial reporting applications (e.g., Dutch Water Boards, FFEIC Call Reports, KOSDAQ, and SEC). This has occurred because governments have the ability to require use rather than waiting for adoption to be driven by market demand. The government agencies can achieve significant cost reductions in data re-entry by requiring the organization furnishing the information to provide the data in a non-proprietary tagged format that allows sharing among multiple application platforms. Currently, companies typically follow a paper-centric process for capturing and reporting financial information tagging the data after the fact using either internal software or external service providers to map the data to the existing GAAP taxonomy extensions.

If companies continue their current process they may see no immediate measurable internal benefits for their efforts other than ensuring statutory compliance and perhaps, as it has been theorized, a benefit from increased analyst coverage and reduced regulatory reporting costs.2 To achieve the maximum benefits offered by XBRL, movement toward a data centric view of information is critical. By tagging data earlier in the process, at the point of data capture, the data can be re-purposed for a greater number of possibilities. To move to this data centric model we move from XBRL for Financial Reporting (XBRL FR) to XBRL Global Ledger (XBRL GL).

Extensible Business Reporting Language Global Ledger (XBRL GL)

Extensible Business Reporting Global Ledger (XBRL GL) provides the means for organizations to move away from an after-the-fact paper-centric model to a data-centric model of tagging information at the point of data capture. However, there appears to be a wide-spread misperception that XBRL GL is a general ledger system which reports debits, credits, and accounts. This narrow definition ignores the potential for XBRL GL to capture more comprehensive information. "XBRL GL, the standardized Global Ledger, is a standard format to represent financial and non-financial data at the detail level, move the data between different systems and applications, and provide context for drilling down from summary reporting (XBRL FR) to the detail data that flows to it," (Garbellotto 2006, 59).

XBRL GL is not intended to take the place of an ERP system, nor is it intended to be a transaction exchange standard in the vein of EDI. It allows users to tag the items in the data warehouse so that those items can be used, reused, and combined with data from other sources. Modules allow "the representation of anything that is found in a chart of accounts, journal entries or historical transactions, financial and non-financial. It does not require a standardised chart of accounts to gather information, but it can be used to tie legacy charts of accounts and accounting detail to a standardised chart of accounts to improve communications within a business" (XBRL Intl. 2009b).3 Moreover, XBRL GL does not require assigning the information to an account. In fact, the information can be associated with end-user financial reporting without being assigned to an intermediary account. Further flexibility exists in that XBRL GL is not tied to any particular set of accounting standards or methods. As such, the information can be simultaneously (or alternatively) reported in accordance with multiple accounting standards (e.g. IFRS and US GAAP) or utilizing different accounting methods (e.g. cash and accrual basis). These characteristics are consistent with those identified by Ushold and Gruninger (1996) as underlying qualities of ontologies.

The GL taxonomy contains elements to capture information such as who entered the purchase order, when the purchase order was entered, the terms, whether the purchase order is chargeable or reimbursable, and the date received. Thus, non-financial information can be captured in addition to the financial facts. XBRL GL is a *global ledger* system that uses approximately 400 elements to represent thousands of elements that depending on the context can represent a broad range of qualitative and quantitative information. The majority of the elements are for operational and reporting details. In fact, there is only one field for the debit or credit and a dozen more for account structure details. The data tags are designed with reuse in mind. For example, the element "identifierContactFirstName" can be re-used with meaning conveyed by the "identifierType" whereby the first name might be that of a supplier contact, a customer or an employee thereby eliminating redundancy of having separate first name elements for supplier, customer and employee.

Further, information about the company reporting the transactions would not typically be captured by the reporting system. By embedding the reporting company's name into the instance document, it continues to be associated with the transactions when the information is consolidated or shared among information supply chain partners. The measurable structure can carry details about services, machine cycles, benchmarking, key performance indicators, fixed assets and other details seldom associated with accounting per se. XBRL GL enhances communication between disparate systems and applications by enabling knowledge sharing and reuse which is the purpose of ontologies as stated by Gruber (1992). Like all XBRL taxonomies, XBRL GL is extensible to meet the diverse needs of internal reporting.

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2 Regulatory reporting costs are reduced when government agencies converge their reporting requirements as was achieved when the Bank Call Report process was modernized (XBRL Intl. 2006).

3 The modular taxonomies that comprise XBRL GL are: Core, Advanced Business Concepts, MultiCurrency, concepts for Saxonic jurisdictions and the tax audit file. While the use of all modules is not required, it is helpful to view each module as part of the whole.

This is particularly important in the area of internal reporting and sharing information across the supply chain as there is greater diversity at the internal and supply chain levels because they are not governed by external reporting requirements. Because the internally-generated taxonomy extensions will need to be maintained indefinitely in the same manner as external taxonomies to provide a stable reference, it is important to plan carefully to reduce the number of changes needed.4 With sufficient forethought the extended taxonomy will likely require minimal periodic changes. Corporations will need to look to the IASC and XBRL International for best practices regarding both taxonomy and schema versioning. XBRL GL has the potential to change how information is consolidated and shared within an organization, and along the financial information supply chain and not just for financial reporting; it may include tax, sustainability, statistics, and management reporting. Consequently, it has the potential to provide support for both financial reporting and the audit process, acting as a catalyst for change in these areas as well. Organizations (e.g., Wacoal, Inc., Housing and Urban Development (HUD) and Fujitsu Limited) that embrace XBRL GL are likely to gain strategic benefits by leveraging their business rules.

A significant benefit offered by XBRL (both FR and GL) is that it provides a method to express semantic meaning and a means to validate the content of an instance document against that semantic meaning based upon taxonomy defined relationships. XBRL GL provides the ability to validate business rules and formulas at various levels within the organization. The use of built-in validations can be achieved through the use of type tags, linkbase validations (i.e., calculation and formula linkbases), XML Schema restrictions, and Schematron.5 Additional benefits of XBRL GL are that it (1) supports consolidations across disparate accounting systems within an organization, (2) supports financial reporting by linking the financial statement elements to the underlying details, and (3) provides a flexible "language" of data interchange through extensibility. XBRL GL will "help make even the most integrated system more interoperable, and data more reusable, in a cost-effective way" (Garbellotto 2006, 60).

Like other XBRL taxonomies, XBRL GL was constructed from a brute-force approach designed to fit current accounting systems rather than built from a fundamental ontological perspective that could be encoded into a taxonomy. However, the nature of its construction does not hinder XBRL GL's ability to satisfy Gruber's (1995, 910) criteria of a "good" ontology (clarity, coherence, extensibility, minimal encoding bias and minimal ontological commitments). In fact, the GL taxonomy achieves (1) clarity through agreed upon definitions, (2) coherence through consistent use across time, (3) extensibility by design, (4) the elimination of encoding bias through agreed upon definitions and the ability to tag data unbounded by the conveniences of notation, and (5) the minimization of ontological commitments by allowing individuals to instantiate the taxonomy as needed.

Resources Events Agents Enterprise Ontology (REA-EO)

Although double-entry bookkeeping has been used for over 500 years, modern day business transactions are increasingly more complex than those of even 50 years ago. As Buder and Koschtial (2009) point out, "double entry bookkeeping cannot store data application neutral" due to implied limitations in storing the financial data. This can limit the ability of the modern ERP system to provide the necessary data for decision making. The REA model (McCarthy 1982) was initially suggested as a means to overcome the limitations of double entry bookkeeping, provide guidance on "what phenomena should be captured in an enterprise system" and offer "structuring guidelines about the way economic phenomena should be assembled into business processes and value chain specifications" (Geerts and McCarthy 2001). Over time it has evolved from an accounting process model to a business process model that can be used by an enterprise to capture all business processes and events.

Partridge (2002) noted that the REA ontology adds two important aspects to traditional double-entry bookkeeping. One important benefit is that it explicitly records both monetary and non-monetary events. "A known inadequacy of double-entry bookkeeping is that the ledger is restricted to monetary entries. … In the REA model, there is no requirement that economic events record the monetary values of economic resources, and the REA model can therefore express exchanges where money is not involved, such as barter trade" (Hruby and Scheller 2008, 2).

4 The term "extension" refers to providing tags to information not currently contained in the relevant XBRL taxonomy and to overriding any labels, presentation links, or calculations in the existing taxonomy.

5 A "schematron is a rule-based validation language for making assertions about the presence or absence of patterns in XML trees" (Wikipedia 2009).

Another important benefit is that it explicitly identifies both parties to an economic exchange. “In double-entry bookkeeping, the proprietor – the owner of the books – is implicit; the trading partners are referred to indirectly as owners of the accounts across which the entries are posted, such as creditor and debtor. Making the parties to the transaction explicit becomes essential in many situations: in the supply chain, where a producer or a dominant trading partner is interested in monitoring the transactions of other partners in the chain; in internal trading in which trading partners are both parts of one entity; and in modeling cooperatives, where a group of peers is interested in modeling the cooperative as a whole, as well as each member’s individual contribution to the cooperative” (Hruby and Scheller 2008).

REA modeling has been discussed as a method for organizational information systems to capture all business processes and events including “any strategically significant business activity management wants to plan, control, and/or evaluate” (Denna et al. 1998, 365). The REA model’s comprehensiveness moves it beyond merely capturing and reporting on business transactions (economic events) to capturing and reporting on other non-transactional business events. Typification, which can be related to resources, events or agents, is a conceptual abstraction that defines the identifying characteristics or essence of a concrete set of objects (i.e., an event type could be a raw materials purchase). It focuses on the recurring components of business events and shares the object-oriented adage of reuse. Therefore, typification allows for increased internal controls through validation checks to determine if the components of a particular business event are of an appropriate type.

The REA model is popular in teaching and modeling accounting systems. However, Geerts (1997, 2) noted that the traditional “REA pattern lacks reusability and extendibility.” Geerts and Wang (2007) illustrate this problem using the example of a car dealer changing its business practice from not accepting trade-ins to accepting trade-ins. This change in business practice necessitates adapting the existing enterprise schema to the new practice. “As a result, the underlying enterprise system must also be recompiled and redeployed, which is often costly and inefficient. … timeless REA systems are able to absorb such changes and make enterprise systems more adaptive” (Geerts and Wang 2007, 165). The designation of a timeless REA system refers to the extensibility of the system, not a system without time. The ability of the system to adapt to changes in the operating environment is consistent with the *state-tracking model* of Weber (1997, 135) thereby eliminating an ontological deficit.

The objective of timeless REA systems is to increase the adaptability of enterprise systems by increasing the reusability and extendibility of the system. “Information systems have a data component or information base and a data structure or conceptual schema that defines the semantics of the data and the constraints that apply to them (ISO 1982). Data structures are typically hardwired into the information system, and changes to them are costly and time-consuming, often requiring the creation or modification of table or object class definitions and additional programming. On the other hand, data manipulation such as adding a new customer is easy to do and the cost is minimal. The objective of timeless enterprise systems is to enable the accommodation of normal changes in the economic activities and business rules of an organization without affecting the underlying data structure and programs. … this can be accomplished by defining semantics and business rules as part of the data component and thus allows users, especially nonprogrammers, to change them at runtime” (Geerts and Wang 2007, 166).

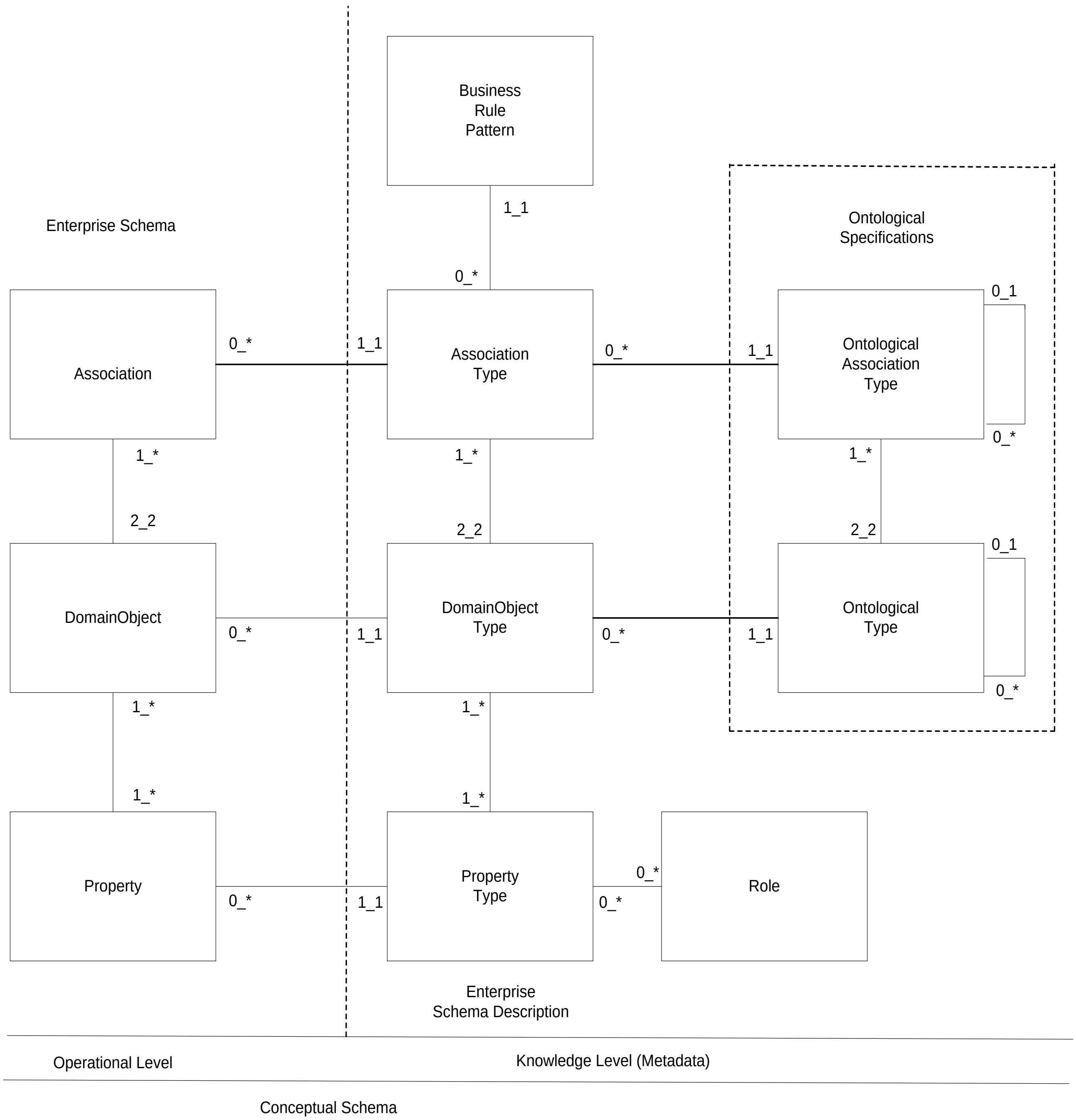
In order to accomplish this, timeless REA systems first analyze the “core concepts underlying the economic activities.” Once commonalities have been identified, “specific exchanges” are replaced by a “generic ‘exchange’ association” in the timeless REA enterprise schema. “As a result, the user can record any current or future exchange between two economic events without making any change to the data structure. However, the increased flexibility comes at a price: reduced semantics” (Geerts and Wang 2007, 168). In addition, “business rules …are no longer defined as part of the enterprise schema. … The ideal situation would be where the specification of the semantics is preserved or even extended while the increased flexibility is maintained. One approach is the use of a reflective architecture where the descriptions of the enterprise schema are integrated as part of the conceptual schema” (Geerts and Wang 2007, 168-169). Figure 1 illustrates this approach where the enterprise schema description provides a framework for describing the semantics of the enterprise schema instead of defining them directly. This allows semantic descriptions to be updated at run time to accommodate changes in business operations without a change to the data structure. Figure 1 also illustrates how extending the conceptual schema with ontological specifications provides a framework to describe the semantics of the REA-EO as part of the information base. Geerts and Wang (2007, 170) note that extending the conceptual schema with ontological specification adds value in the following ways:

1. Ontological specifications can be used for validation purposes.
2. Adherence to the REA-EO results in interoperability.
3. Changes in the ontology itself can easily be accommodated by the architecture.
4. The explicit definition of the ontology provides additional knowledge that can be used as part of applications.

With the increased attention to internal control resulting from Section 404 of the Sarbanes-Oxley Act of 2002 (SOX), the enhanced internal control through typification can provide significant benefit to the organization.

Figure 1:

Conceptual Schema for Timeless REA Enterprise Systems (Geerts and Wang 2007, 169)

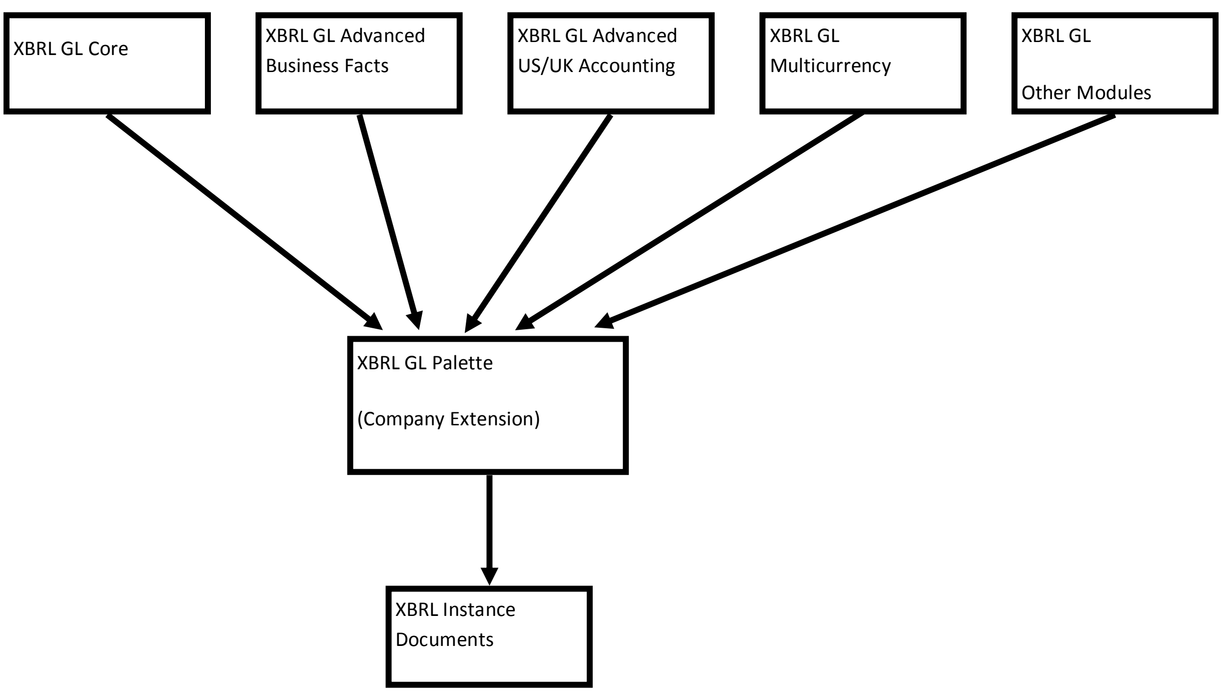


While a timeless REA enterprise system built using a reflective architecture offers significant benefits in terms of adaptability, "applications built with reflective systems need to access metadata at runtime and are more complex to write and need more processing resources and time" (Geerts and Wang 2007). In addition, this type of REA system still uses a proprietary approach that does not facilitate the sharing of information since it is not typically shared across organizations and can even vary between different systems within the same organization. Efficient business operations require timely information sharing between subsidiaries and among trading partners. Using the timeless REA-EO model to guide the extension of the XBRL-GL taxonomy is one way of addressing this need by allowing the sharing of tagged information.

III. EXTENDING THE XBRL GL TAXONOMY WITH THE REA MODEL

REA is focused on business *processes*; it does not have an explicit and comprehensive set of data items representing the content of trade documents. XBRL GL provides such a vocabulary; key benefits of XBRL GL include the use of agreed upon definitions for tagged items and extensibility to meet the individualized needs of industries and individual organizations. REA provides theoretical guidance on how to expand that vocabulary in a consistent manner when needed. This is where integration of REA and XBRL GL is beneficial. Garbelloto (2006) gives recognition to the need for extensions for jurisdiction, company, and functional add-ons. Figure 2 illustrates how the different modules of the GL taxonomy can be combined with company specific extensions. The need to extend the XBRL GL taxonomy to meet the specific requirements of the enterprise necessitates a determination of how to accomplish this task. Further any extensions should be designed to maintain the objectives of XBRL GL. Using fundamental ontological and design principles to guide these extensions will maintain the GL objectives, prolong the usability of the extensions, and likely reduce not only the time but the costs of implementation and maintenance.

Figure 2:
XBRL GL, The Journal Taxonomy Framework (XBRL Intl. 2005)



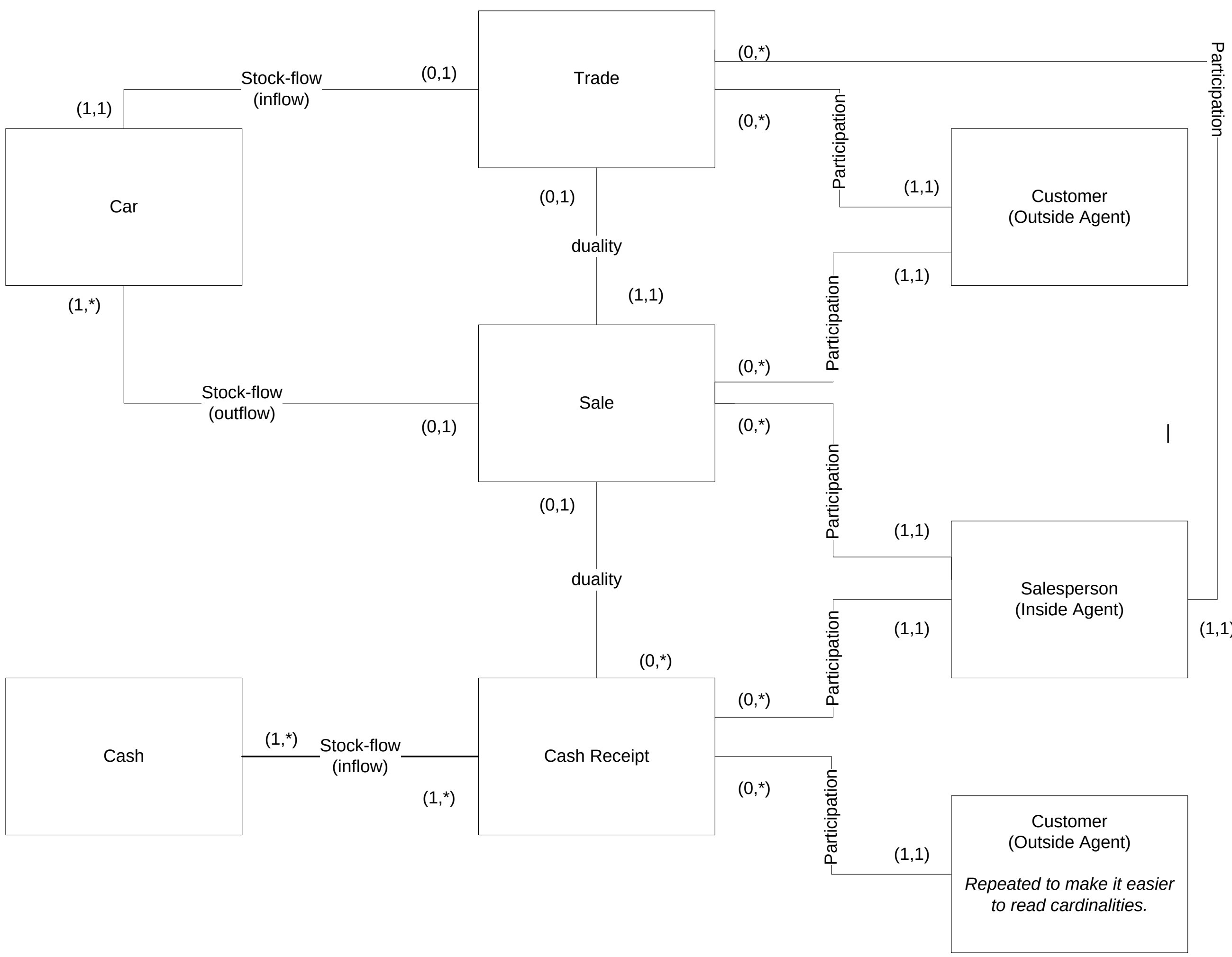
In order to maximize the potential benefits of XBRL GL, the organization must determine which financial and non-financial information to capture. We propose using the timeless REA-EO model to guide the taxonomy extension process. By using the timeless REA-EO model it is possible to develop a more complete set of data tags that will allow better leverage of organizational business rules than would likely be possible with an ad hoc extension process.

The timeless REA-EO model is appropriate for several reasons. First, like REA-EO the underlying XBRL GL taxonomy is based on Resources, Events, and Agents. XBRL GL captures the Resources within the 'measurable' structure, the participation relationship (i.e., Agents) within the 'identifierReference' structure, and the duality relationship (i.e., Events) at the 'entryDetail' level then it ties the structures together through the value-chain. For example, both the company and the external agent are tagged in a purchase transaction. Second, XBRL GL is designed to tag both economic and non-economic data which is consistent with the REA model. For example, we can capture and record information about sales and successful sales calls. Third, both build internal controls into the system. Fourth, both leverage reusability. Fifth, both believe that the information from calculated fields should not be stored. Sixth, neither requires the use of accounts. Therefore, it is only logical that REA be used to guide the extension process so that the extensions are consistent with the existing GL taxonomy. REA provides a process for modeling the information and XBRL GL provides a means to capture and share the information. By addressing the question of what common information to represent across organizations and what nuances to represent within the organization, REA can help to guide extensions, modifications, and implementations of the XBRL GL taxonomy.

To illustrate the process we will build on the Geerts and Wang (2007) Exhibit 7 "Conceptual Schema for Timeless REA Enterprise Systems" (illustrated in our Figure 1) using the domain objects from the Geerts and Wang (2007) Exhibit 4 as modified in our Figure 3 to include the internal agent salesperson. It should be noted that it is also possible to include the Ontological Specification in the taxonomy extension.6

Figure 3:

REA Enterprise Schema: Economic Activities of a Car Dealer accepting Trade-Ins (adapted from Geerts and Wang (2007, 166) Exhibit 4)



6 We left Ontological Specifications out of the taxonomy extension for simplicity purposes.

It is necessary to identify structures already present in the XBRL GL taxonomy before beginning the extension process. The GL type tags use drop-downs to limit the choices to valid types. For example, the XBRL GL Core Taxonomy contains the 'documentType' element which includes choices such as 'order-customer,' 'order-vendor,' and 'invoice.' The use of 'documentType' allows us to define the 'Association Types' from the Enterprise Schema. We would need to modify the enumerated choices to include trades, which is industry specific. Section 2.5.3 of the General Ledger Taxonomy Framework Technical Architecture (XBRL Intl. 2007a) describes how to modify the enumerated values in the relevant content taxonomy file (i.e., gl-xxx-content-2005-11-07.xsd where xxx refers to cor, bus, muc, usk, or taf). The existing XBRL GL taxonomy makes use of tuples to bind information together. For example, all of the information about a customer, such as customer number, name, address, and phone number would be bound together. The use of tuples will allow us to bind the 'property type' data to the 'domain object type.'

It is important that taxonomy extensions are consistent with the existing XBRL GL taxonomy. Extensions should be created that look beyond creating elements that are quick-fix and limited use. One way to accomplish this is the use of existing standards. ISO/PRF 3779 specifies the structure for vehicle identification numbers. For example, the elements 'make,' 'model,' and 'year' are captured in ISO/PRF 3779 "Road Vehicles--Vehicle Identification Number (VIN) " (ISO 2009). Relying on an existing standard increases the consistency of data tagging by not having individual companies create unique extensions.

'Property type' defines the name, role, and data type. We can define the data type (e.g., integer, string, or date) for an element in the taxonomy. The GL Core Taxonomy already defines the element 'amount.' The meaning for 'amount' is determined by the source journal; therefore, 'amount' from the sales journal would be the amount of the sale and from the cash receipts journal would be the amount of the receipt. Therefore it would not be necessary to extend the taxonomy for the trade amount. While not necessary, if desired, the 'Description' tag could be used to provide additional information about the amount which like 'amount' takes on meaning based on where it appears in the instance document. The GL 'identifierType' element allows an automated system to understand who is being described within the context of this entry. For example, by knowing the identifier type 'v,' 'c,' or 'e' we know the information that follows, such as, number, name, and address, correspond to information about a vendor, customer, or an employee, respectively.

XBRL GL has the potential to overcome the complexity and performance decreases inherent with the reflective architecture of the timeless REA-EO schema through the use of data tags that maintain the metadata. The resulting extension should be reusable, consistent, and developed in a logical manner that will withstand the test of time. The REA infused taxonomy extension will capture a more complete set of business information (e.g., type of salesperson, type of trade) and XBRL will allow us to use that information across disparate reporting systems. By capturing additional information such as salesperson or trade type we can perform additional business rule validations. By using XBRL GL, if the owners of the car dealership had multiple dealerships they would be able to consolidate the data across platforms that likely vary by the dealership make (e.g., Ford, GM, or Honda). In addition, they could share information with the auto manufacturer and lenders. The business rules can be changed in the information base allowing increased flexibility to capture the ever changing business environment. Internal controls are improved through instantiations being validated against the type tags.

To summarize, our proposal addresses some of the problems that have been encountered in trying to implement the use of XBRL GL (e.g., XML's lack of semantics) by guiding the development of taxonomies and customized extensions in a rational and systematic manner in accordance with the REA-EO. The result of combining the XBRL GL and the REA-EO allows organizations to develop taxonomy extensions that maintain the essential characteristics of "good" ontologies as discussed in Gruber (1993)--clarity, coherence, extensibility, minimal encoding bias and minimal ontological commitments. Current technology is sufficient to implement our proposal For example, Altova MapForce and Fujitsu's Taxonomy Editor and Instance Creator with the available XBRL GL add-in can be used to map the information from the company database to the XBRL GL taxonomy.

IV. CONCLUSIONS

Given the rapid growth and implementation of XBRL it is important to consider all aspects, from taxonomy development through taxonomy use, reporting and consumption. Because of the fundamental impact of taxonomy development on subsequent use and consumption we undertake the process of examining how REA-EO can be used to serve as the modeling grammar for XBRL GL taxonomy extensions.

The synergies available from the combination of REA and XBRL (i.e., reusability, extensibility, and interoperability) can benefit organizations worldwide. Our paper examines how using the REA-EO as a structured framework to guide XBRL GL taxonomy extensions, such as company specific extensions, will maintain consistency and inherent benefits such as gains in adaptability, reusability, extensibility, and interoperability. This approach acknowledges the importance of having a business reporting system capable of efficiently capturing and communicating key financial and non-financial business information and performance measures within a firm and across the business supply chain. Recognizing the weaknesses of traditional business reporting systems in performing this task while adhering to the needs of the organization, we propose using REA to extend the XBRL GL taxonomy to address those needs.

REA provides a model for determining what information should be captured and how it should be tied together while XBRL GL provides the technology to share that information among disparate systems. This is true both in the case of a fully developed timeless REA system tagged in XBRL GL and in the case of legacy systems tagged in XBRL GL with extensions guided by REA. Further investigation and development are needed in order to fully realize the potential complimentary benefits of REA and XBRL GL. During the interim, incremental benefits can still be achieved. Utilizing REA to guide the XBRL GL taxonomy extension process within the organization could also have the added benefit of advancing management's understanding of their organization and identifying opportunities for improvements in operations. Information is the key to success in today's fast-paced global marketplace. Being able to use information to act and react quickly allows an organization to gain a strategic advantage over its competitors. A primary benefit to be derived from combining REA and XBRL GL lies in tagging and sharing information at the economic event level and using that information to make smarter, faster decisions.

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